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Description

ORIFICE SEALING PHYSICAL BARRIER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority as a Continuation-In-Part to U.S. Patent Application No. 09/992,365 filed on November 19, 2001 and Patent Cooperation Treaty Application No. PCT/US02/36308 filed on November 13, 2002; the contents of each are incorporated herein in their entirety.

FIELD OF THE INVENTION

[0002] This invention relates to devices and methods for sealing orifices in panel members.

BACKGROUND OF THE INVENTION

[0003] Physical barriers are commonly used to seal orifices in certain objects, such as panel members in motor vehicles, buildings, household appliances, etc. These barriers normally are used to prevent physical materials, fluids, and gases, such as environmental contaminants, fumes, dirt, dust, moisture, water, etc., from passing through the ori-

fice or cavity. For example, an automotive panel, such as a door panel, typically has several small orifices in the sheet metal, which are created for various reasons during manufacturing. Further, various structural components of automobile bodies have a variety of orifices, hollow posts, cavities, passages and openings that can allow contaminants from the engine and the roadway into the passenger compartment. These holes, orifices, and cavities are typically barricaded with duct tape, butyl-based plastic patches, and sealing plugs made from foam, rubber or some other material. Another known physical barrier for cavities involves introducing a foam product into the cavity, and using a fiberglass matting to fill in the cavity.

[0004] One type of known physical barrier is a combination of a metal carrier and a patch of heat flowable material. The metal carrier is inserted into and retained in the orifice to be sealed. Next, the patch is overlaid on the carrier and heated so as to form a seal over the orifice. The metal carrier supports the center of the patch so as to prevent the patch from collapsing into the orifice. This solution is unsatisfactory for a number of reasons. First, the metal carrier is difficult to install into the orifice. Namely, a force multiplying tool and/or a machine is needed to apply a

large amount of force to sufficiently flex the retaining means on the metal carrier to allow installation. Second, the metal carrier is heavy while also being relatively expensive to manufacture. The use of other materials for the carrier has previously been limited because patch materials have not been available which adhere to disparate materials. For example, known patches adhere only to metal. Thus, previously both the panel member and the carrier were required to be metal.

[0005] Further, when a carrier is inserted into and retained in the orifice to be sealed, differences in material thicknesses often produce a gap between the carrier and the panel member. With traditional physical barriers, the patch is applied over the carrier and thus any gap between the carrier and the panel member remains. Thus, contaminants present in the gap are trapped. Additionally, the gap may expand or retract under operating conditions and thus produce a seal failure by separating the patch from the panel member.

[0006] Accordingly, there is a need for a physical barrier that produces an effective and robust seal about the orifice of the panel member. Specifically, a physical barrier that overcomes the possible seal failures associated with the

gap between the carrier and the panel member is greatly desired.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention is a physical barrier for an orifice in a panel member which includes a plastic carrier having a peripheral edge. The present invention further includes a patch adapted to adhere to the plastic carrier and the panel member. The patch is attached to a portion of the plastic carrier and encapsulates the peripheral edge of the plastic carrier.

[0008] Additionally, the present invention includes a method of sealing an orifice in a panel member. The method includes the step of joining a patch made of a heat-activated material to a portion of a plastic carrier such that the patch encapsulates a peripheral edge of the plastic carrier. Next, the plastic carrier is attached to the panel member. Finally, the plastic carrier is adhered to the panel member with a portion of the patch disposed between the plastic carrier and the panel member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the drawings:

[0010] FIG. 1A shows an expanded view of a physical barrier ac-

cording to the present invention.

[0011] FIG. 1B shows a perspective view of a physical barrier according to the present invention.

[0012] FIG. 2 shows an exploded view of a physical barrier according to the present invention.

[0013] FIG. 3A shows a perspective view of a carrier according to the present invention.

[0014] FIG. 3B shows a perspective view of a physical barrier according to the present invention.

[0015] FIG. 4A shows a perspective view of a carrier according to the present invention.

[0016] FIG. 4B shows a perspective view of a physical barrier according to the present invention.

[0017] FIG. 5A shows an expanded view of a physical barrier according to the present invention.

[0018] FIG. 5B shows a perspective view of a physical barrier according to the present invention.

[0019] FIG. 6 shows a cross-sectional view of the physical barrier of FIG. 1B according to another embodiment of the present invention.

[0020] FIG. 7 shows a cross-sectional view of the physical barrier of FIG. 3B according to another embodiment of the present invention.

[0021] FIG. 8 shows a cross-sectional view of the physical barrier of FIG. 5B according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The physical barrier 10 of the present invention consists of a plastic carrier 12 and a sealer patch 14 as shown in FIG. 1. Carrier 12 includes a deck 16 and at least one snap-fit fastener 18. Together, carrier 12 and patch 14 form physical barrier 10 for an orifice in a panel member, where deck 16 supports the center of patch 14, such that patch 14 does not collapse into the orifice. Carrier 12 and patch 14 may be shaped and sized to accommodate any orifice in the panel member.

[0023] The at least one snap-fit fastener 18 in FIG. 1 is a plurality of protrusions 20 which are generally perpendicular to the plane of deck 16. These protrusions encompass a majority of the perimeter defined by the protrusions. Protrusions 20 include an edge 22 and a holding surface 23.

[0024] The at least one snap-fit fastener 18 in FIGS. 2, 3 and 4 is a plurality of S-shaped clips 24. The long axis of S-shaped clips 24 lies in the place of the carrier deck 16. S-shaped clips 24 include a holding surface 25 and may include a tail 26.

[0025] The at least one snap-fit fastener 18 in FIG. 5 is a circumferential trough 28 with a lip 30 included on a continuous circumferential outer wall 32 of trough 28. Outer wall 32 also includes a holding surface 33.

[0026] Snap-fit fasteners 18 may be any fastener which causes carrier 12 to snap into position, *i.e.*, into the orifice to be sealed. The snap-fit fasteners illustrated in FIGS. 1-5 are not meant to be limiting, but rather only demonstrative.

[0027] As shown in FIGS. 1, 4 and 5, deck 16 may include a circumferential ridge 34 which defines a recess into which a protrusion (not shown) on patch 14 may be placed. This helps ensure that the patch 14 is properly place on the carrier. The ridge-protrusion combination also helps to the patch remain in place during insertion of the physical barrier into the orifice.

[0028] As shown in FIGS. 3 and 4, carrier 12 may also include multiple legs 36, which are positioned between snap-fit clips 24 and are oriented away from patch 14.

[0029] Now referring to FIGS. 6-8, another embodiment of the physical barriers 10 of FIGS. 1-5 is disclosed. Specifically, the plastic carrier 12 includes a peripheral edge 40. In FIGS. 1-5, the edge 22 of FIG. 1, the tail 26 of FIGS. 2-4, and the lip 30 of FIG. 5 each define the peripheral edge 40

of the plastic carrier 12. To generate a more effective seal when received in the orifice of the panel member, patch 14 is attached to at least a portion of plastic carrier 12 and encapsulates the peripheral edge 40 of the plastic carrier 12.

[0030] As shown, the patch 14 is attached to the plastic carrier 12 and supported by the deck 16. To encapsulate the peripheral edge 40, a portion of the patch 14 is wrapped around and under the edge 22, tail 26 or lip 30 and attached to a bottom surface 42. Preferably, the patch 14 is bonded to the bottom surface 42 by a technique such as vacuum-forming (described below). However, any technique that secures the patch 14 around the edge 22, tail 26, or lip 30 of the plastic carrier 12 to encapsulate the peripheral edge 40 is contemplated by the present invention. Accordingly, when the physical barrier 10 is received in the orifice, a portion of the patch 14 is disposed between the plastic carrier 12 and the panel member. Specifically, a portion of the patch 14 is disposed between the bottom surface 42 of the edge 22, tail 26, or lip 30 and the panel member.

[0031] Patch 14 is made of a thermoplastic material that flows when activated with heat and adheres to both plastic and

metal. Any thermoplastic which adheres to both metal and plastic is suitable for use in the present invention. Adherence to both metal and plastic is an attribute that has not been previously produced in thermoplastic materials.

[0032] In one useful embodiment, patch 14 contains an ethylene-vinyl acetate (EVA) copolymer combined with a styrene butadiene rubber (SBR). One useful EVA is the ELVAX® 400 series from Dupont. A suitable SBR is the 1006 material from Ameripol Synpol Corp of Akron, OH.

[0033] Patch 14 may also include suitable fillers such talc, mica, tall oil rosin and/or other conventional fillers for thermoplastics. Talc selected for inclusion in patch 14 may be of highly pure platy talc such as one or more chosen from the 9900 series from Polar Minerals of Wellsville, OH, while utilized mica may be a phlogopite mica such as one or more chosen from the 5000 series, also from Polar Minerals. A suitable tall oil rosin may be selected from the SYLVAROS series from Arizona Chemical Co. of Jacksonville, FL.

[0034] In one embodiment, EVA is present in amounts of 10-40 wt %, while SBR is present in amounts of 5-35 wt %. The balance includes 5-22 wt % talc, 10-45 wt % mica and 10-30 wt % tall oil rosin. A particularly useful material for

patch 14 is a composition of 29 wt % EVA, 16 wt % SBR, 12 wt % talc, 26 wt % mica and 17 wt % tall oil rosin.

[0035] Carrier 12 may be made of conventional plastic materials, with the only consideration being the activation temperature for patch 14. Thus, carrier 12 must be able to maintain its physical rigidity at the activation temperature; *i.e.*, carrier 12 should not melt at temperatures used in the chosen heat source. When used in vehicles, the carrier should withstand temperatures normally utilized in the paint and coating drying ovens. While metals may be used, plastics are preferred because of the reduced amount of force needed to install a plastic carrier as compared to a metal carrier. One useful plastic material is nylon.

[0036] Physical barrier 10 may be made by conventional methodologies. Carrier 12, separate from patch 14, can be formed, *inter alia*, by vacuum forming, injection molding or extrusion. Patch 14 may be formed by similar techniques. Once individually formed, carrier 12 and patch 14 may be attached to each other prior to installation into a cavity. An appropriate adhesive may be used, but heat staking is preferred. Heat staking is a process by which two plastic parts are effectively spot welded together.

[0037] Methodologies of making carrier 12 and patch 14 parts into one integral piece may also be utilized. Insert molding, which uses two molds, and two shot molding, which uses one mold, are suitable methods of making barrier 10 where carrier 12 and patch 14 are integral.

[0038] As introduced above, and specifically with the embodiments of FIGS. 6-8, patch 14 and plastic carrier 12 may be joined by traditional vacuum-forming techniques generally known to one skilled in the art. The thermoplastic material of patch 14 is extruded into a sheet and secured in a vacuum-forming apparatus (not shown). Similarly, the plastic carrier 12 is also loaded into the vacuum-forming apparatus. Optionally, the plastic carrier 12 may receive an adhesive prior to being loaded into the vacuum-forming apparatus. The typically heat-activated or pressure-activated adhesive facilitates the effective attachment of the patch 14 to the plastic carrier 12. Next, heat is applied and the sheet of material of patch 14 is molded over a portion of the plastic carrier 12 and around the peripheral edge 40 by vacuum or suction. Pressure is often applied and the joined plastic carrier 12 and patch 14 are cooled. The joined plastic carrier 12 and patch 14 are then cut from the sheet of material of patch 14. In vacuum-form-

ing the patch 14 to the plastic carrier 12, the amount of heat applied is limited such that the patch 14 remains generally solid and the plastic carrier 12 maintains its physical rigidity.

[0039] The installation of barrier 10 is now described. Barrier 10 is inserted into the orifice to be sealed. The snap-fit fasteners flex as carrier 12 is seated in the panel member. Edges 22, tails 26 or lip 30 (peripheral edge 40) ensure that carrier 12 is not over inserted into the orifice. Protrusions 20, legs 36 or outer wall 32 ensures that carrier 12 is centered and not twisted in the orifice to be sealed. Holding surfaces 23, 25, 33 are the locations on the respective snap-fit fasteners which abut the panel member after carrier 12 has been installed.

[0040] By centering carrier 12, the maximum amount of strain all snap-fit fasteners 18 have to endure is significantly reduced. This reduces the strength of snap-fit fasteners that are needed to properly install barrier 10, which in turn reduces the amount of force needed to install barrier 10. Thus, force-multiplying tools or machines are not needed to install the barriers of the present invention.

[0041] After installation, patch 14 is activated to produce a contaminant-tight seal. Patch 14 is activated by heating the

patch sufficiently to cause it to flow. Upon cooling, patch 14 will adhere to carrier 12 and the panel member surrounding the orifice. Any source of heat may be used to activate patch 14. One particularly useful heat source is an oven associated with drying coatings and paints on vehicles. These ovens operate at multiple temperatures depending on the coating or paint being dried, and typically operate between about 175° F and about 400° F.

[0042] Patch 14 adheres the plastic carrier 12 to the panel member by producing a seal at the interface therebetween. When the patch 14 encapsulates the peripheral edge 40 of plastic carrier 12 (FIGS. 6-8), a portion of the patch 14 is disposed between the plastic carrier 12 and the panel member. Specifically, a portion of the patch 14 is disposed between the bottom surface 42 of the edge 22, tail 26 or lip 30 and the panel member. Often when the plastic carrier 12 of the physical barrier 10 is received in the orifice of the panel member, variations in material thickness produce a gap between the plastic carrier 12 and the panel member. The portion of patch 14 disposed between the plastic carrier 12 and the panel member fills the gap therebetween. Hence, a very robust, effective and complete seal is formed about the orifice of the panel mem-

ber.

[0043] Plastic carriers with snap-fit fasteners are highly advantageous over known metal carriers because no separate tools or machines are necessary to insert the carrier into a cavity. Metal carriers often require a tool to bend retention tabs at the time of installation. Furthermore, the amount of force required to properly seat the carrier in the orifice is significantly less with a plastic carrier compared to a metal carrier. Plastic carriers may be installed by hand. The reduced amount of required installation force means less problematic installations. The use of plastic carriers is permitted through the use of a patch which will adhere to disparate materials, *i.e.* , plastic and metal. Such a patch has not previously been available.

[0044] While the invention has been specifically described in connection with certain specific embodiments thereof, it is to be understood that this is by way of illustration and not of limitation, and the scope of the appended claims should be construed as broadly as the prior art will permit.